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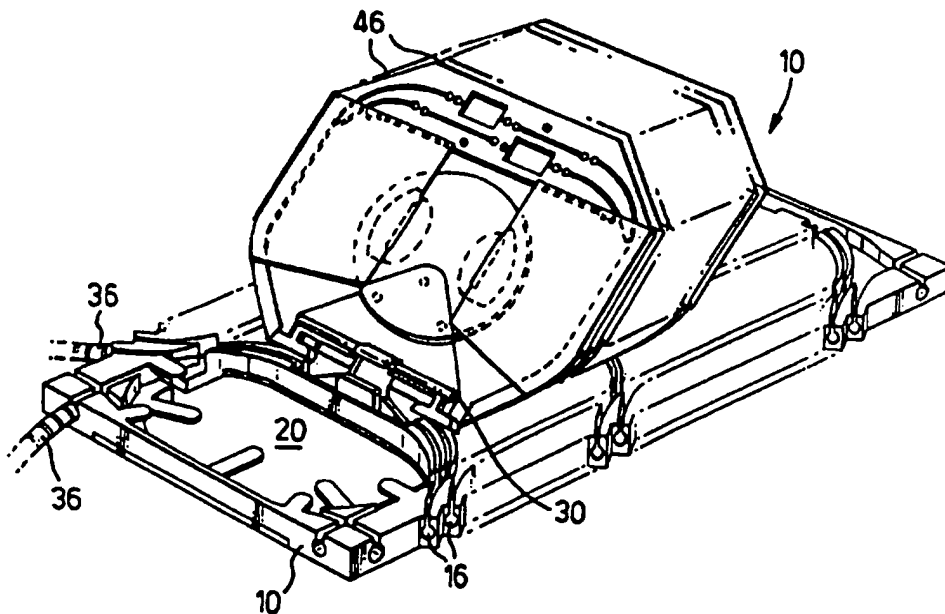
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(54) Title: A SPLICE TRAY

**(57) Abstract**

A splice tray is disclosed for accommodating optical fibres. The tray comprises a body (10) with a plurality of splice holders (46) at fixed locations thereon, the body having fibre access points (16) at which fibre (36) can enter and leave the body. Fibre paths (40, 42) are provided on the body leading from the access points (16) to and from each splice holder (46), and each holder is adapted to receive and hold a splice reinforcer (30) within which a fibre splice is present. The body (10) is provided with means (42) to accommodate the length of fibre either side of the splice. There is also disclosed an adaptor (figure 11) by which a clip-on power meter can be used to take readings of the transmissivity of fibres stored on storage leaves (46) mounted on the tray body.

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A SPLICE TRAY

This invention relates to a splice tray for accommodating optical fibres.

Where optical fibres have to be connected to one another, a splicing technique is used.

5 The splices have to be stored carefully and with an ample supply of fibre on either side of the splice so that the splice can, if necessary, be remade. Since fibres are normally routed in fibre bundles, it is normal for a large number of fibres to be spliced in the same physical location.

It is therefore conventional to provide a splice tray in which the splice and an associated
10 fibre can be accommodated.

It is always desirable to reduce the volume needed for storing multiple splices, provided that this can be done without comprising the requirements of safe storage and subsequent access.

15 In one aspect the invention provides a splice tray for accommodating optical fibres, the tray comprising a body with a plurality of splice holders at fixed locations thereof, the body having fibre access points with which fibre can enter and leave the body, and fibre paths on the body leading from the access points to and from each splice holder, each holder being adapted to receive and hold a splice reinforcer within which a fibre splice is present, and the body being
20 provided with means to accommodate a length of fibre of either side of the splice.

Preferably at least some of the splice holders are removably mounted at the fixed locations.

This feature permits a particularly flexible arrangement to be provided in which different types of splice and respective fibre storage arrangement may be accommodated simply by using an appropriate holder.

5 Preferably a fibre storage chamber is provided to accommodate lengths of fibre, and fibre paths on the body provide routes between each splice holder and the chamber. In a preferred embodiment a plurality of splice holders are arranged in a first plane on the body and the fibre storage chamber lies in a second plane beneath the first plane.

10 In addition an auxiliary fibre storage chamber may be provided at one end of the body.

Optical fibre associated with each splice may be stored in one of the chambers on the tray. However some of the splice holders may support a fibre storage leaf upon where fibre for the respective splice is stored. Preferably the leaf is hingedly secured to a base part.

15

In order to test fibre circuits without interrupting the circuit, it is known to use a so-called clip on power meter. In order to use such a meter, each single fibre has to be accurately held within a "window" of predetermined size to allow the weight to operate. It is important that provision should be made for using such a meter to test each individual fibre circuit. In another aspect the invention provides a splice tray for accommodating optical fibres, the tray comprising
20 a body with a plurality of leaves attached to the body, the body having fibre access points at which fibre can enter and leave the body, and fibre paths on the body leading from the access point to and from each leaf, each leaf having means for receiving and retaining a splice and a length of fibre either side of the splice, wherein each leaf also has windows through the leaf

material, with fibre guides on the leaf arranged so that a fibre on each side of the splice traverses one of the windows, the leaf being adapted to receive an adaptor by which a clip on power meter can be used to take readings of the transmissivity of each fibre, accessing the fibre through one of the windows. The invention also provides a method of measuring the transmissivity of an optical fibre, wherein the fibre is located on a leaf hinged to a splice tray body and the leaf has a window cut through the leaf material, the fibres on the leaf arranged so that the fibre traverses the window, the method comprising the steps of fitting an adaptor to the leaf so that a window on the adaptor registers with the window on the leaf, and connecting a clip on power meter to the adaptor to take readings of the transmissivity of the fibre.

The invention also provides an adaptor for providing an interface between a clip on power meter and a fibre storage leaf, the adaptor having windows therethrough for the operation of a meter and plates for mounting on opposite faces of the leaf to allow a meter to be brought into operating association with a fibre stored on the leaf.

The invention also provides an optical fibre clamping device for preventing relative movement between an optical fibre and a protective tube within which the fibre is located which comprises a body part including a through passageway to receive the optical fibre, the body part including the first clamp to engage the tube and a second clamp to engage the optical fibre. Preferably the device comprises a one piece moulding including two parts connected by a hinge and arranged such that closure of the device causes respective clamps to engage the tube and optical fibre.

The invention will now be further described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of the body of a splice tray in accordance with the
5 invention:

Figure 2 shows schematically some fibre paths on the tray body;

Figure 3 is a perspective view of the body of Figure 1 with splice holders in the form of
10 hinged leaves mounted thereon;

Figure 4 shows more detail of one of the hinged leaves;

Figure 5 is a detail of part of the fibre guide arrangement of the hinged leaf of Figure 4:
15

Figure 6 shows on a larger scale the engagement between the leaf of Figure 4 and the tray
of Figure 1;

Figures 7 and 8 illustrate the way in which fibre is loaded onto a hinged leaf;
20

Figure 9 is a perspective partial view of the body of a splice tray with a different type
of splice holder.

Figure 10 is a perspective view of an alternative splice tray and splice holder

arrangement.

Figure 10a is a perspective view of part of the tray shown in Figure 10:

5 Figure 11 shows an adaptor for adapting the leaf to the requirements of a clip on meter, before application to a leaf:

Figure 12 shows the application of the adaptor to a hinged leaf; and

10 Figure 13 shows the adaptor in place and ready for a reading to be taken.

15 The tray body 10 shown in Figure 1 is a plastics moulding which has fibre access ports at 12, 14 and 16. The access ports are constructed so that fibre can be laid into the ports, rather than being threaded through the ports, with a sheath 36 (Figure 2) for the fibre or fibre bundle being axially insertable in the circular mouth of each port.

20 The body 10 is made up of two components, namely a main upper housing 18 and a bottom plate-like closure 20. A dark fibre pocket 22 is defined between the upper and lower components 18, 20 in which fibre which is not connected to a light source can be stored. A live fibre storage area 21 is formed at the front end of the tray.

Fibre stored in the pocket 22 or in the area 21 will expand radially, when released, as a result of its natural elasticity and will come to lie against the outer peripheral edges of the pocket or of the storage area 21. In the area 21, the fibre coils will be retained under retention fingers

24, 24a.

Down the centre of the upper component 18 there is a space 26 for receiving fibre splices and/or hinged single fibre loop control leaves 46 (Figures 3 to 10). The space 26 includes upstanding posts 28 which locate and retain splices and/or leaves. Many tracks (for example 40, 42) in which fibre may be laid are moulded on the top face of the upper component 18. All the moulded fibre tracks are set up to ensure that the fibre is never bent through a radius smaller than the minimum permissible bend radius for the fibre, but a variety of fibre routes are possible within the moulded-in-tracks. For example, Figure 2 shows two fibres 32, 34 entering the tray through access ports 16 on opposite sides of the tray, and joining each other in a splice 30. One fibre 32 is shown by a thick line and the other fibre 34 is shown by a thin line. Figures 32 and 34 are live fibres. The thickness of these lines is purely for illustration purposes. In fact both fibres may be of the same thickness. Before they enter the tray, the fibres are protected by protective sheaths 36.

15

The fibre 32 first of all travels through a track 42 and crosses the upper surface of the tray through a splice holder (not shown) located on upstanding posts 28. The fibre then passes through an opposed track 42 and down the longitudinal track 40 into the pocket 21. The fibre is coiled within this pocket the necessary number of times to store the requisite length of fibre, and then the fibre is directed out of the pocket 21, passing above the fingers 24 and below fingers 24a into the second longitudinal track 40 and then into a different selected one of the curved tracks 42.

20

The other fibre 34 follows a similar path. The fibres are connected by a splice 30 which

is made by a splicing tool, known in the art. In order to make the splice, a certain length of fibre needs to be available to the splicing tool. The splice itself is contained within a rigid, cylindrical tube and, once made, is contained within a splice holder (not shown, but mentioned above) which is retained in the space 26 by the posts 28.

5

This method of storing live fibre on the tray in the pocket 21 is known as multi-fibre storage. In a second configuration to be described below, live fibre can be stored in single loops, separate from other fibres.

10

Dark fibre which is brought onto the tray and stored there ready for use in the future passes (often as a multi-fibre bundle) from an access port 16, along a track 40 to the far end of the tray where it is coiled up and introduced into the dark fibre pocket 22 through an opening or openings 23.

15

Figure 3 shows the tray 10 with a number of fibre storage leaves 46 hinged to the tray. The leaves 46 are all shown inclined backwards, in a storage position, but it will be understood that each leaf can be individually hinged about an axis parallel to the plane of the tray body 10. If access is required to a leaf 46 in the middle of the array, then the leaves in front of this desired leaf can be hinged forwards; those behind can be hinged backwards and the desired leaf can be held in an upright position so that access can be achieved to that leaf and to the fibre thereon.

20

Figure 4 shows details of one leaf 46. A loop storage part of the leaf is vacuum formed from a thin sheet plastics material. The material can be 0.4 mm thick PVC, and after vacuum forming, the depth of the leaf can be suitably 2 mm deep.

At the centre, the leaf has a raised circular capstan 48, the radius of which is equal to the minimum bend radius of the fibre to be stored. A loop of fibre is held in an area generally designated 50 and, when the loop is released within this area it will naturally expand outwards against the outer walls 52 of this area.

5

The leaf includes two windows 54, 56 across which the fibre is to be passed. Each of the windows 54, 56 is in register with a fibre track 58, 60 and the tracks include retaining slots through which the fibres must be threaded, in line with the tracks 58, 60. These slots are shown in Figure 5 and comprise the channels 58 which, when the leaf 46 is vacuum formed, are terminated in blank end walls. After forming, the material of the leaf is punched through to remove these blank end walls thus opening a passage beneath a bridge 62. A fibre 32 is shown passing through one of these retaining slots.

10

In addition to the windows 54, 56 the leaf is provided with locating holes 64, the function of which will become apparent later on.

15

The leaf has hinged retaining doors 66 connected by membrane hinges at 68 to the main part of the leaf. The doors have tongues 70 which can be flexed to engage in retaining apertures 72 at the centre of the leaf. When the doors are closed, fibres within the leaf are retained in position.

20

In order to attach the leaf 46 to the body 10, a hinged, base unit 74 is used. The base unit is accommodated in the same space as a simple splice holder, when this is used in a multi-fibre storage arrangement. Figure 6 shows, on a scale larger than that used in the preceding figures,

a base unit 74. The base unit has a triangular region 76 with three studs 78 which are positioned to engage in holes 80 on the leaf 46. A permanent connection will be made between these posts and the holes, for example by sonic welding the two together.

5 Between the triangular portion 76 and the foot 82 of the base, there is a membrane hinge which will allow the triangular portion 76 with the attached leaf to turn about an axis parallel to the body 10. On the foot 82 are two ramps 84 which line up with the fibre tracks 42 in the body 10, when the base is fully inserted into the space 26. The ramps 84 guide the fibre from the tracks 42 up into the fibre loop control leaf 46.

10 Adjacent the hinge on the base 74 is a channel 86 for receiving a splice 30, and a retention tab 88 is fitted so that the splice can be snapped into the channel 86 and retained there.

 Figures 7 and 8 show the way in which the tray will be used to accommodate fibres. As
15 in Figure 2, the two fibres which will be connected together to form a single fibre loop are shown by thick 32 and thin 34 lines.

 The fibre 32 comes onto the tray through a sheath 36, passes along a track 42, up a ramp
84 and onto the fibre loop control leaf 46. From there it makes a loop, the free end of the fibre
20 32 is guided through retention slots 62 to ensure that the orientation of the fibre with relation to the window 56 is generally as required, passes across the window 56 and around the capstan 48 before its free end is taken to a position far enough away from any obstructions to allow it to be spliced to the free end of the fibre 32.

The other fibre 34 follows a path which is similar to that of the fibre 32, but a mirror image thereof.

When the free ends of the fibres 32 and 34 meet at the location of the splice 30, they are
5 spliced together in a known way.

Once the splice has been made the resulting fibre loop is twisted through 180° (see figure 8) and the splice 30 is then moved down so that it can clip in the channel 86, 88 and when this happens the spare fibre loop will locate within the fibre loop control loop 46, the door 66 of
10 which can then be closed to retain the fibre. Figure 12 shows the completed leaf 46 with the fibre and its splice 30 stored thereon.

Figure 9 shows a partial perspective view of a tray together with a different type of splice holder. In this embodiment a splice reinforcer 30 is retained inbetween a space defined between
15 two bar like retaining elements 100. Each retaining element 100 is formed from a plastics material having flexible side walls 101. A hole 102 is provided at each end of the member 100 which mates with the pegs 28 provided on the splice tray body for holding the member in position. A notch 103 is provided so that, when two such members are inserted side by side a splice reinforcer 30 inserted in the space defined between them can be removed.

20

Figure 10 shows a different type of splice tray body of generally similar construction to that shown in Figure 1. The protective bend limiting tubes 36 are connected to the tray body by clip like members, as described in co-pending patent application GB 9506505.8 and shown in more detail in Figure 10a. Essentially each clip device 105 comprises a one piece moulding

which includes two substantially identical halves 105a, 105b connected by a hinge 105c. The interior of the device is hollow and defines a through passageway 106. One end of the device is dimensioned to receive a protective tube 36 and to provide a means of clamping the device to that tube. The tube 36 includes axially spaced ring like grooves 107 and the device includes co-operating internal ridges (not shown) to prevent the device being pulled away from the tube 36. A pair of jaws 108 are provided at the other end of the device and are arranged to gently nip the optical fibre 32 to prevent it from being pulled through the device, but without causing microbending of the fibre. The bend limiting tube 36 is secured by closing the device from an open condition around one end of the tube and such that the fibre is gripped by the clamps 108 after which the lugs 109 inserted into their respective holes 109a. Because of engagement of the lugs 109 in the recesses 109a, the tube 36 is fixed relative to the optical fibre 32 and any relative movement between them is prevented. Other means may be provided for securing the device to the tray body. As shown two types of splice holder are provided, a simple one 100 of the type shown in Figure 9, and also a splice holder 110 comprising a fibre storage leaf 111 hingedly attached to a base part 112. The fibre storage leaf 111 incorporates windows 113 for attachment to an adaptor for a clip-on power meter, as will be described later on. The splice holder 110 may be made by injection moulding. In a preferred embodiment both the loop storage part 111 and the base part 112 may be made as a single injection moulded part.

Instead of the co-operating peg and hole arrangement of the tray body shown in Figure 1, the body 104 contains a plurality of opposed inwardly extending convex recesses 115 which mate with correspondingly concave protrusions 116 on the splice holders. In alternative embodiments these two components may be reversed.

Figures 11, 12 and 13 show how the resulting fibre circuit is checked and measured using a clip-on power meter. Clip-on meters used for this purpose are well known in the art. These meters require a specific and accurate positioning of the fibres either side of the splice. The vacuum formed sheet which forms a leaf 46, or the injection moulded leaf shown in Figure 10 may not be able itself to provide the accurate positioning, so a separate removable jig or adaptor 90 is used for this purpose. The jig is shown in its folded condition in Figures 11 and 13. Figure 12 shows the jig hinged open to be fitted onto the edge of a leaf 46. A pair of locating studs 92 project through the locating holes 64 and a pair of v-shaped guides protrude through each of the windows 54, 56. As these guides pass through the windows, so they centralise the fibre 32 or 34 so that the fibre comes to lie in an accurately controlled position across the window. The upper leaf 96 of the jig 90 is then closed to trap the fibre in position. This condition is shown in Figure 11, and with the jig 90 arranged as shown a clip-on meter can be applied to the jig 90 to take the required readings of the fibre transmissivity. The jig 90 can be made of a precision material, for example aluminium or a high quality engineering plastic so that it can be made to precise dimensions. However only one such precisely made component is required to make it possible to take readings off each fibre leaf arranged on the tray 10, and indeed this same jig or guide can be used to take readings from other similar trays.

The tray described here with its several low volume, low cost leaves allows the separate storage of multiple single circuit via fibres so that the fibres in each individual circuit can be easily tested with a convention clip-on power meter.

The tray described can also be used with a fibre splitter. In this case, a conventional splitter arrangement can be mounted below or otherwise adjacent to the tray body 10 and the

split or broken out fibres can pass onto the tray through the fibre access ports 12, 14 or 16 or through apertures (not shown) in the bottom closure 20. The fibres will then be handled on the tray as previously described.

CLAIMS

1. A splice tray for accommodating optical fibres, the tray comprising a body with a plurality of splice holders at fixed locations thereon, the body having fibre access points at which fibre can enter and leave the body, and fibre paths on the body leading from the access points to and from each splice holder, each holder being adapted to receive and hold a splice reinforcer within which a fibre splice is present, and the body being provided with means to accommodate a length of fibre either side of the splice.
5
2. A splice tray as claimed in Claim 1, wherein at least some of the splice holders are removably mounted at the fixed locations.
10
3. A splice tray as claimed in Claim 1 or Claim 2, wherein a fibre storage chamber is provided to accommodate lengths of fibre, and fibre paths on the body provide routes between each splice holder and the chamber.
15
4. A splice tray as claimed in Claim 3, wherein a plurality of splice holders are arranged in a first plane on the body, and the fibre storage chamber lies in a second plane beneath the first plane.
- 20 5. A splice tray as claimed in Claim 4, wherein an auxiliary fibre storage chamber is provided at one end of the body.
6. A splice tray as claimed in any preceding claim, wherein splice holders of different configuration are provided on the body, the different configurations of splice holders

each being adapted to receive and hold a splice reinforcer of a different splice reinforcing system.

7. A splice tray as claimed in any preceding claim, wherein at least some of the splice holders support a fibre storage leaf.
8. A splice tray as claimed in Claim 7 wherein the leaf is hingedly mounted to a base part of the splice holder.
9. A splice tray as claimed in Claim 7 or 8 wherein each leaf has means for receiving and retaining a splice and a length of fibre either side of the splice, each leaf also having windows through the leaf material, with fibre guides arranged on the leaf arranged so that a fibre on each side of a splice traverses one of the windows, the tray being adapted to receive an adaptor by which a clip-on power meter can be used to take readings of the transmissivity of each fibre, accessing the fibre through one of the windows.
10. A splice tray as claimed in Claim 9, wherein the windows are provided with displaceable covers.
11. A splice tray as claimed in any of Claims 7 or 10 wherein each leaf comprises a base part with the retention clip positively locating a fibre splice thereon, and a loop storage part, wherein the base part is adapted to connect to the tray body and incorporates a hinge.
12. A splice tray as claimed in Claim 11, wherein the loop storage part of each leaf is made

by vacuum forming a thin plastic sheet.

13. A splice tray as claimed in Claim 11 wherein the loop storage part of each leaf is made by injection moulding.

5

14. A splice tray as claimed in any one of Claims 11 to 13 wherein the base part is an injection moulding.

10

15. A splice tray as claimed in Claim 13 wherein the base part and the loop storage part are made as a single injection moulded part.

16. A splice tray as claimed in any one of Claims 11 to 15 wherein the loop storage part is formed with a shallow depression into which a fibre loop can be laid.

15

17. A splice tray as claimed in any one of Claims 11 to 16, wherein the loop storage part is provided with doors which can be closed to retain a fibre loop.

18. A splice tray as claimed in Claim 17, wherein the doors are formed in one and the same vacuum forming or moulding operation as the leaf itself.

20

19. A splice tray as claimed in any of Claims 7 to 18 wherein the leaves are hinged on parallel axes, with all the fibre storage leaf axes lying in a single plane.

20. A splice tray for accommodating optical fibres, the tray comprising a body with a

plurality of leaves attached to the body, the body having fibre access points at which fibre can enter and leave the body, and fibre paths on the body leading from the access point to and from each leaf, each leaf having means for receiving and retaining a splice and a length of fibre either side of the splice, wherein each leaf also has windows through the leaf material with fibre guides on the leaf arranged so that a fibre on each side of a splice traverses one of the windows, the leaf being adapted to receive an adaptor by which a clip-on power meter can be used to take readings for transmissivity of each fibre, accessing the fibre through one of the windows.

21. An adaptor for providing an interface between a clip-on power meter and a fibre storage leaf which forms part of a splice tray according to any of Claims 7 to 20, the adaptor having windows therethrough for the operation of a meter, and plates for mounting on opposite faces of a leaf to allow a meter to be brought into operating association with a fibre stored on the leaf.

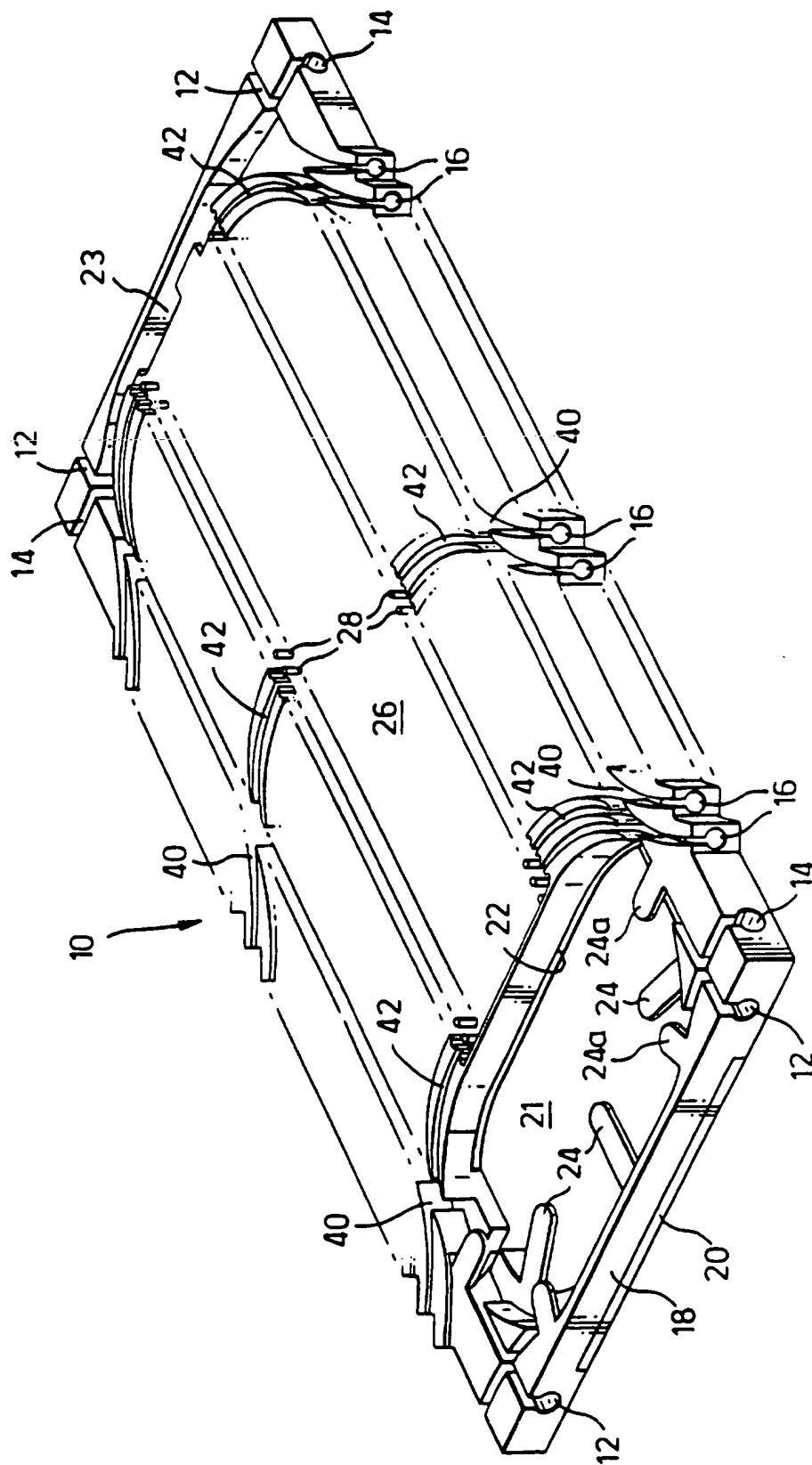
22. An adaptor as claimed in Claim 21, wherein the plates are hinged together along one edge.

23. An adaptor as claimed in Claim 21 or 22, with a positive location feature for locating it in the correct position on a leaf.

24. In combination, a splice tray as claimed in any one of Claims 7 to 20 and an adaptor as claimed in any one of Claims 21 to 23.

25. A splice tray substantially as described with reference to any one of the accompanying drawings.
26. An adaptor substantially as described with reference to any one of the accompanying drawings.
- 5
27. A method of measuring the transmissivity of an optical fibre, wherein the fibre is located on the leaf hinged to a splice tray body and the leaf has a window cut through the leaf material, with fibre guides on the leaf arranged so that the fibre traverses the window.
- 10 the method comprising the steps of fitting an adaptor to the leaf so that a window on the adaptor registers with the window on the leaf, and connecting a clip-on power meter to the adaptor to take readings of the transmissivity of the fibre.
28. A method as claimed in Claim 27, including the step of removing the meter and the adaptor from the leaf after the reading has been taken.
- 15
29. A method as claimed in Claim 27 or 28, wherein the leaf and the adaptor each have a plurality of windows.
- 20 30. A method of measuring the transmissivity of an optical fibre, substantially as described with reference to any of the accompanying drawings.

Fig.1.



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Fig.2.

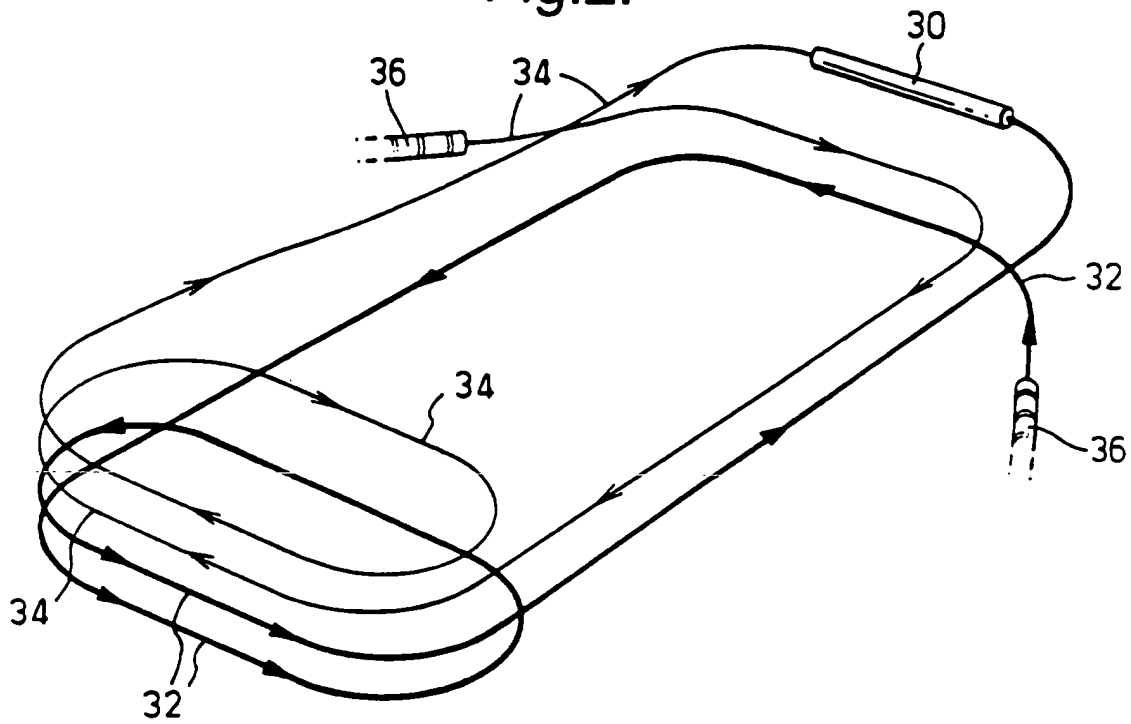
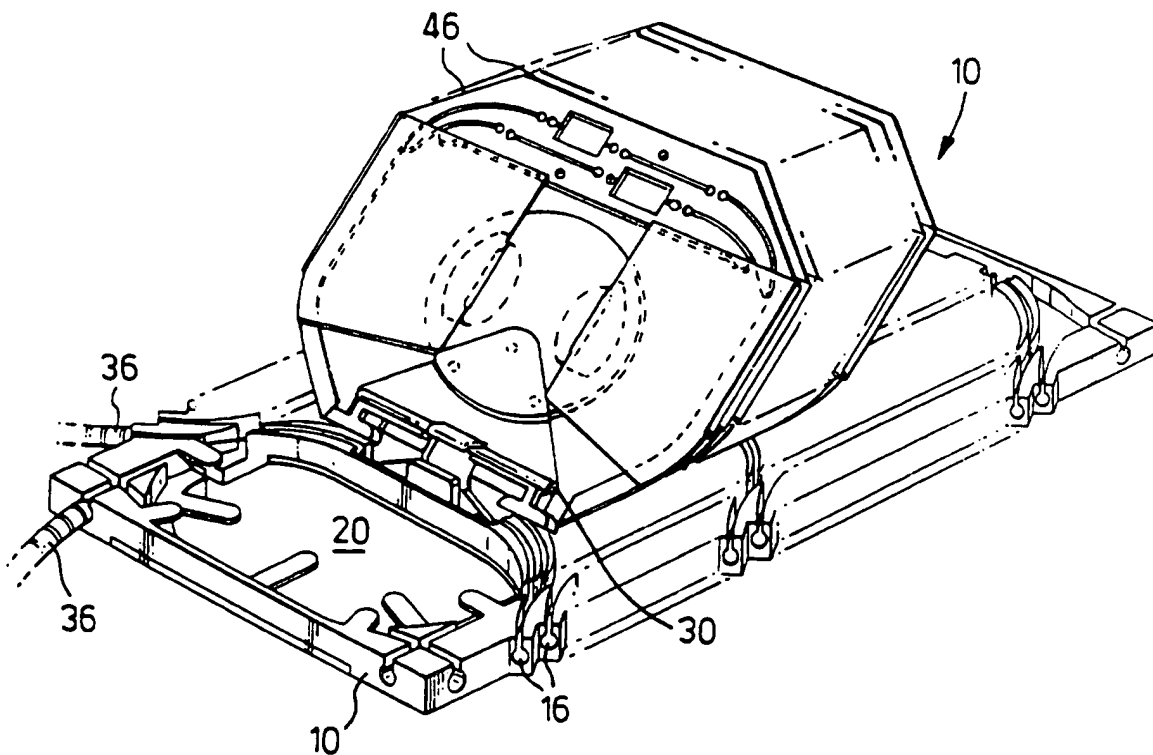


Fig.3.



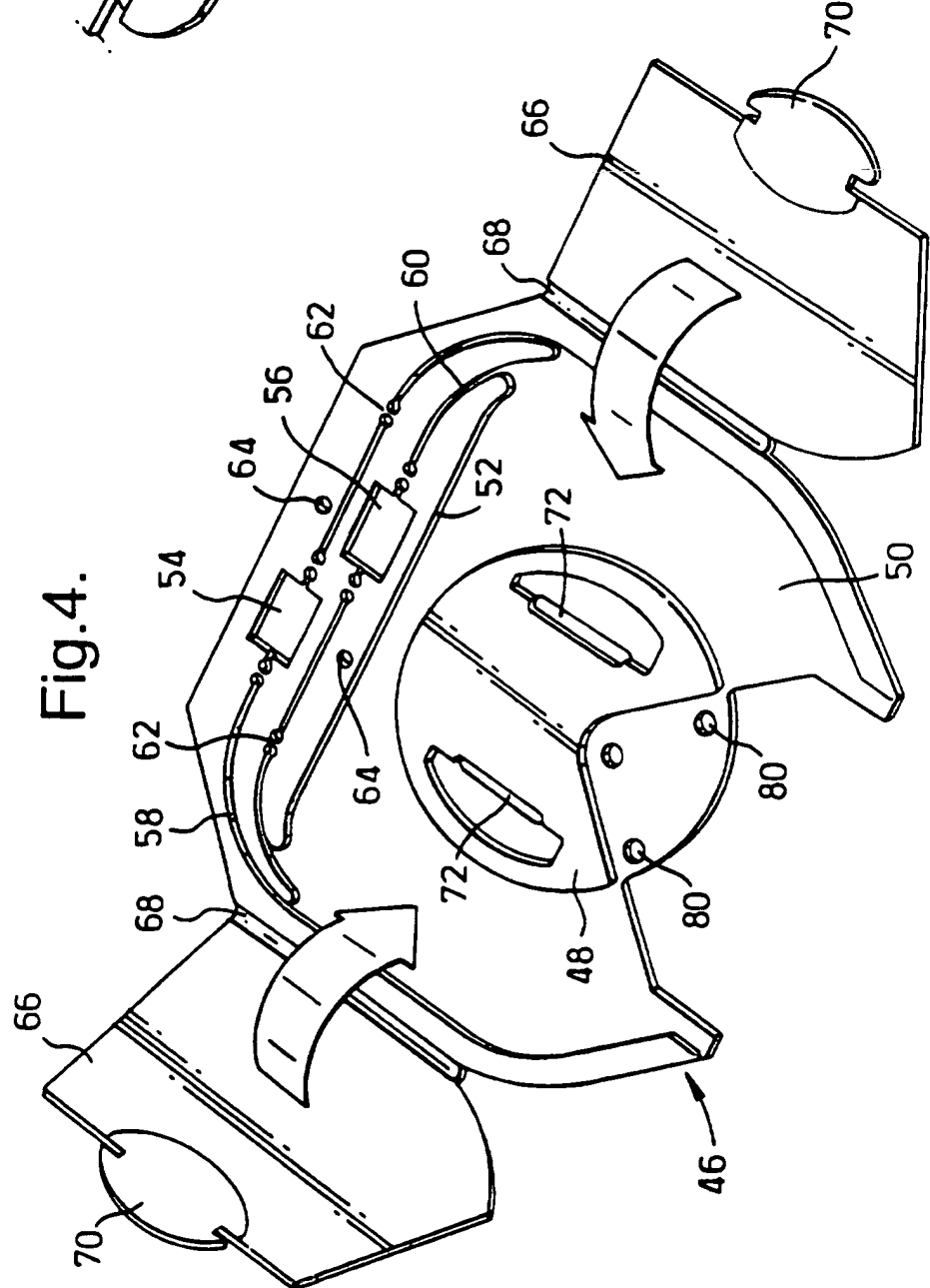


Fig. 4.

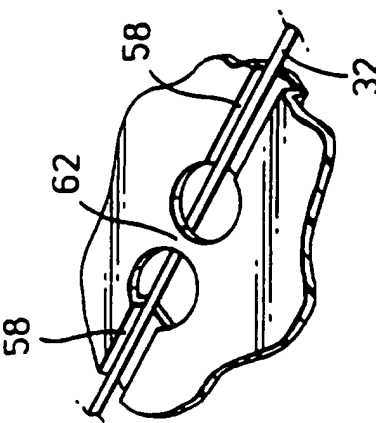
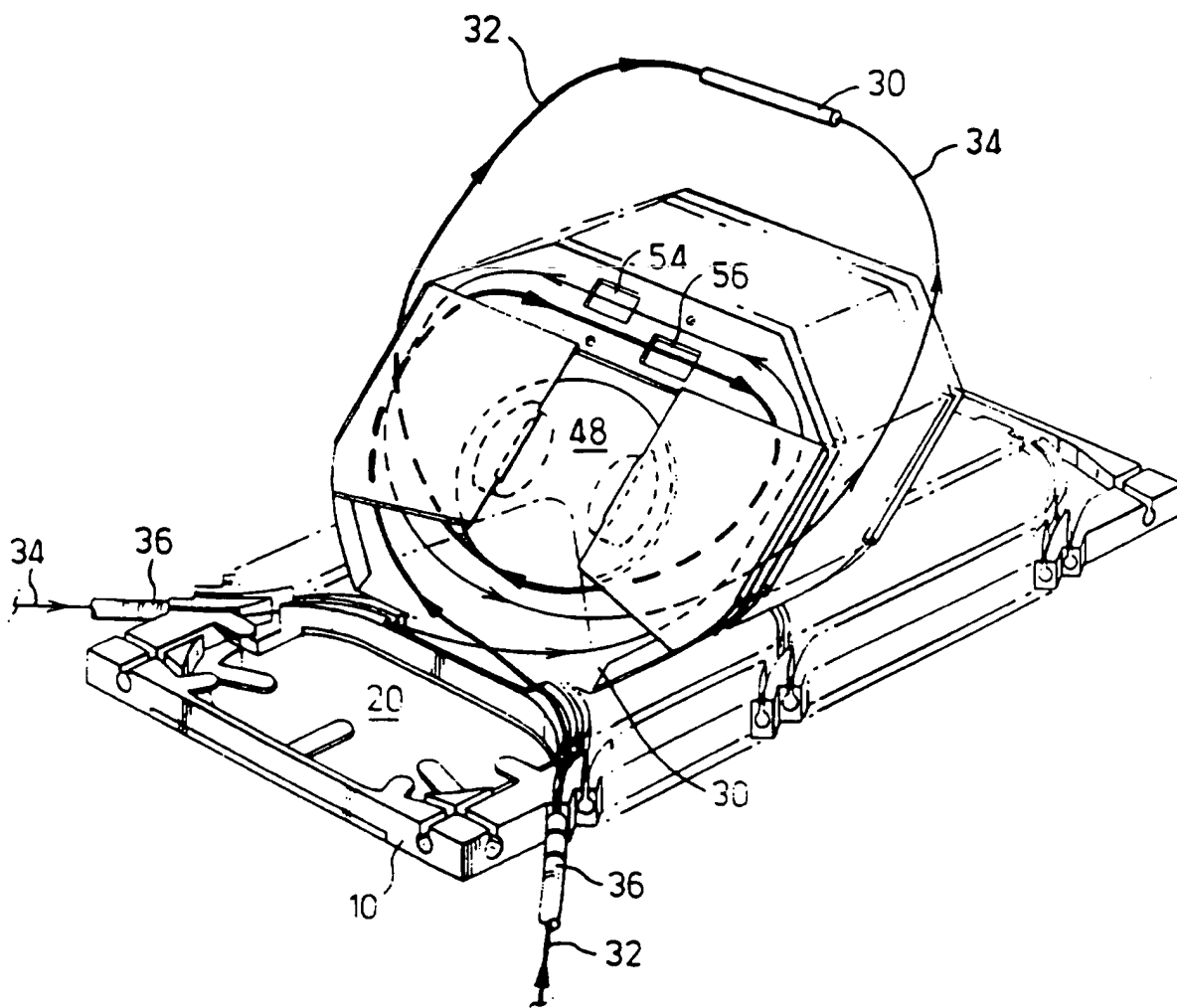


Fig. 5.

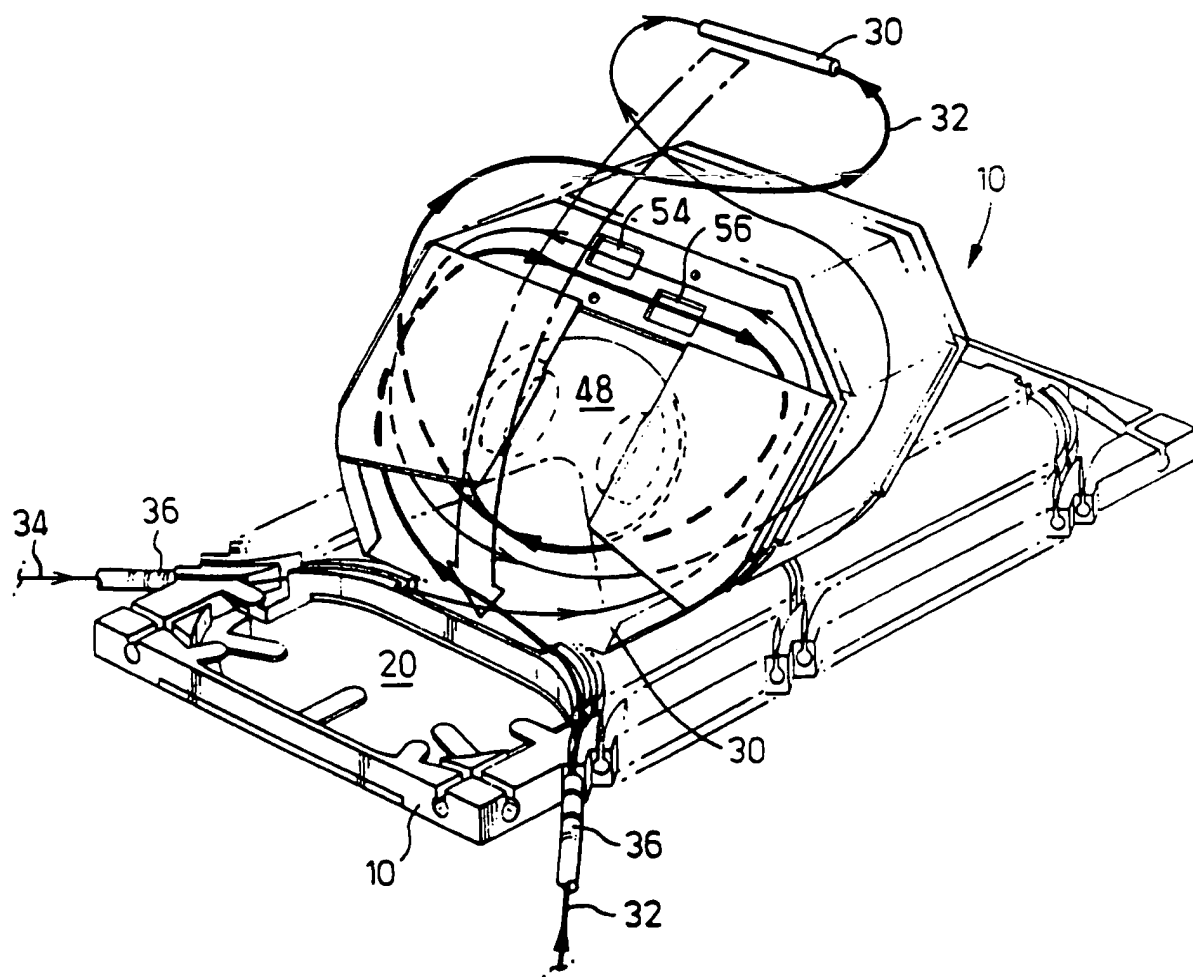
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Fig.7.



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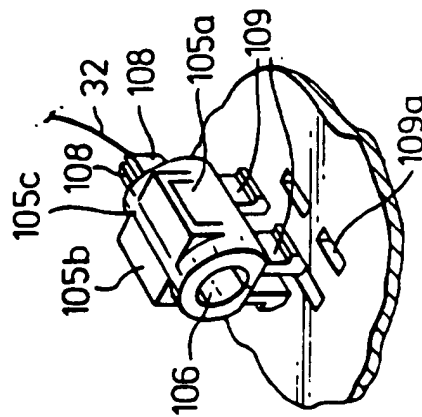
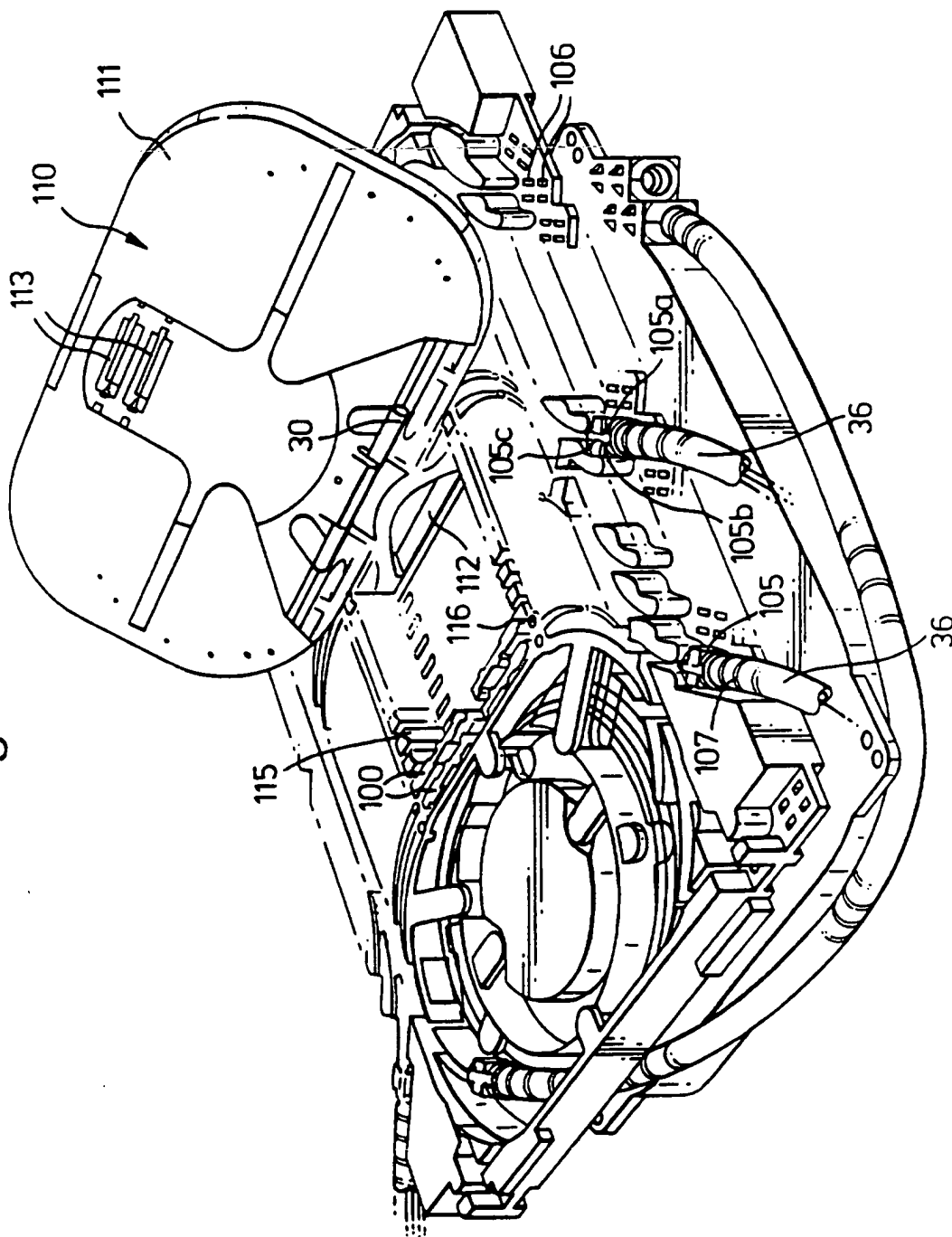
Fig.8.



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Fig.10 a.

Fig.10.



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Fig.11.

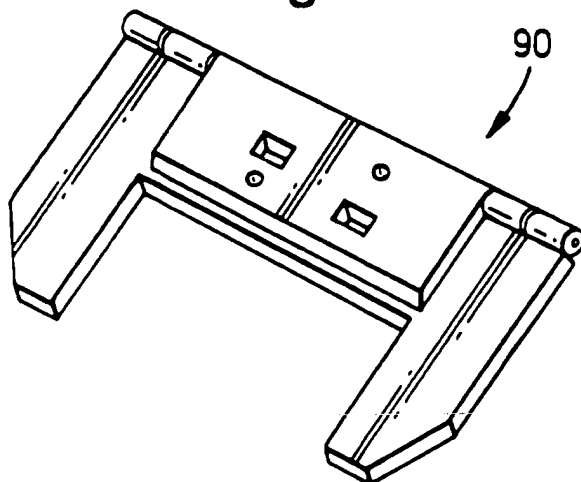


Fig.12.

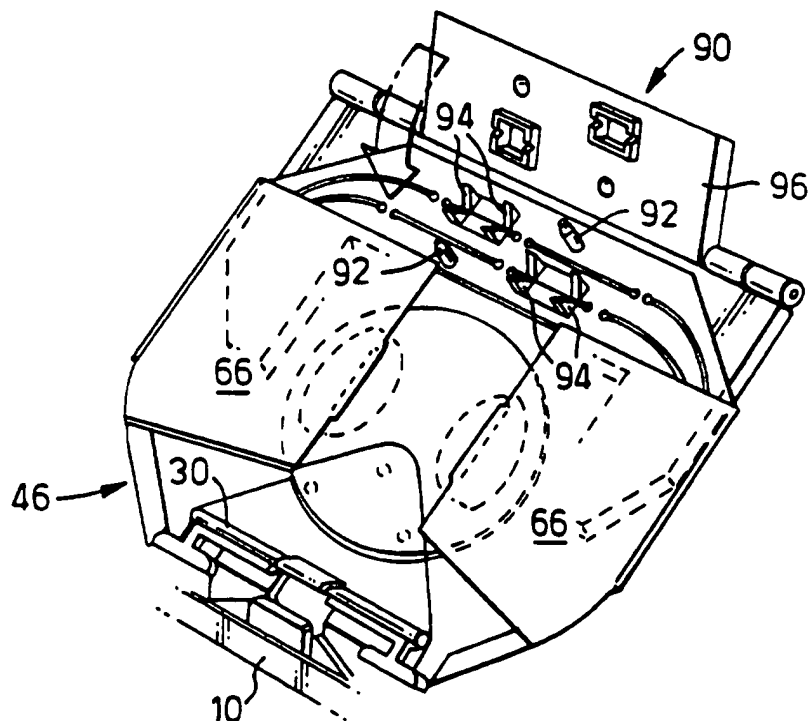
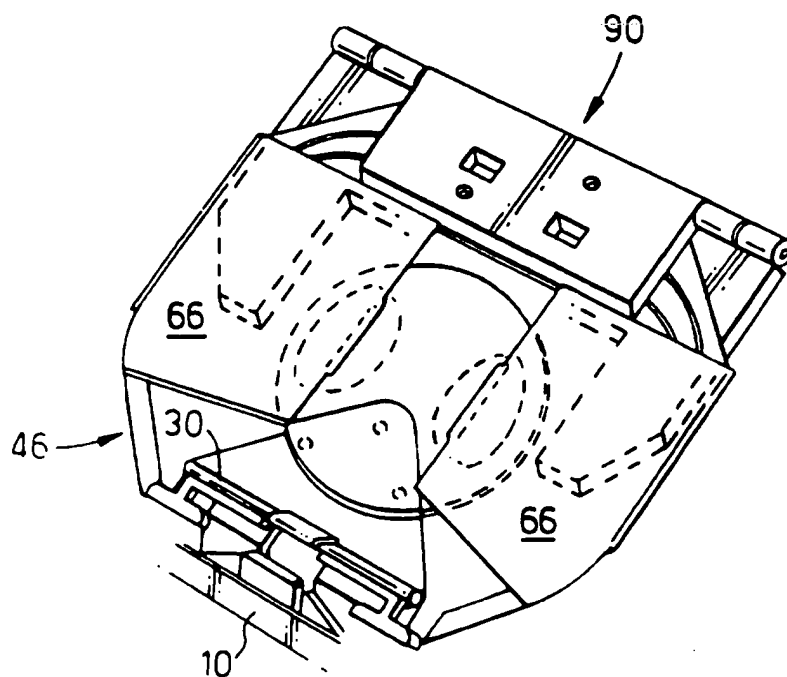


Fig.13.



INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G02B6/44 G02B6/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE,A,31 36 738 (ROSE WALTER GMBH & CO KG) 31 March 1983 see claims; figures ---	1-3,6,7, 20
A,P	WO,A,94 23324 (RAYCHEM LTD ;RAYCHEM SA NV (BE); DAEMS DANIEL (BE); MACKEN LUK (BE) 13 October 1994 see claims; figures ---	1-4,6,7, 11,19,20
A	EP,A,0 594 913 (MOREL ATEL ELECTROMECH) 4 May 1994 see claims; figures ---	1,7,9,11
A	US,A,5 265 187 (MORIN JOSEPH O R ET AL) 23 November 1993 see claims; figures ---	1,21,27
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

11 January 1996

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INTERNATIONAL SEARCH REPORT

International Application No

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C(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 008 no. 219 (P-306) ,5 October 1984 & JP,A,59 102208 (NIPPON DENSHIN DENWA KOSHA) 13 June 1984, see abstract ---	1
A	US,A,5 142 661 (GRANT WILLIAM D ET AL) 25 August 1992 see claims; figures ---	1
A	US,A,4 793 682 (COOPER DAVID A) 27 December 1988 see claims; figures ---	1
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